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With Two Plates.

(Continued from page 3 of cover.)

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It has long been known that there are few endemic genera of ants in the portion of America which lies north of the tropics. The great majority of the genera in our temperate area are also found in Europe and northern Asia or belong to the large southern component of our fauna which is simply an extension of Neotropical groups. Of our native genera which, of course, do not belong in either of the above categories, there are less than a dozen all told. Because of its peculiar faunal composition one might suppose that this small endemic ant fauna of North America would have attracted special attention. Actually, however, the very limited citation of many of these forms in myrmecological literature appears to indicate that the opposite has been the case. For this lack of observation the myrmecologist cannot altogether be blamed. A number of the species belonging to these genera are rare and are frequently confined to areas whose inaccessibility or climate renders field work difficult. In the case of the two genera discussed in this paper there is the added difficulty of specific recognition, since the literature contains no keys to the various species. While the ecological data presented in this paper are often all too scanty, the authors trust that the publication of an adequate taxonomic analysis of the species belonging to the genera Novomessor and Veromessor may serve as a stimulus for the observations needed to round out our knowledge of these interesting insects.

The greater portion of the material upon which this study is based is in the collection of the senior author and was in large part secured by him during trips to the southwestern United States in 1905, '10, '17, and '28. This material has been augmented by specimens taken by the junior author during the summers of '32 and '33. In addition, through the courtesy of Dr. W. M. Mann, we have been able to examine his valuable collection which contained several new forms herein described. The authors wish to express to Dr. Mann their sincere appreciation of his kindness. Dr. M. R. Smith has also very kindly contributed specimens for which we wish to thank him.

It seems necessary at the outset to stress the fact that Novomessor and Veromessor have little in common except a preference for arid country. In structure, nesting habits, and phylogenetic relationships the two genera are distinctly different. Indeed one may note a difference in their geographical distribution for, despite the fact that both are customarily regarded as Sonoran, their ranges are in large part separate. That confusion has resulted in the past from their inclusion in a single group will be shown in the sequel.

The taxonomic history of the two genera is not particularly involved. Following Mayr's original description of *albisetosus* in 1886 the species in our present genus Novomessor were ordinarily regarded as belonging to Ischnomyrmex, which was at that time held to be a subgenus of Aphaenogaster. The species which we now assign to the genus Veromessor were usually considered to be American representatives of the Old World Messor. There is something to be said in defense of such a view. At least it separates the two distinctly different groups which Emery in 1915 (1)[1] united to form the genus Novomessor. There can be no question but that Emery intended to relieve the genera Aphaenogaster and Messor of incongruous species. It is strange, however, since he was able to evaluate the relatively slight differences which separate Novomessor and Aphaenogaster as matters of generic consequence, that he should have failed to realize the much greater differences between Novomessor and Veromessor. The matter becomes even more incomprehensible when one reflects that Emery himself described *Veromessor stoddardi*, one of the most outstanding species in the genus.

The inconsistency of Emery's view was partly corrected two years later by Forel who in 1917 (2)[1] separated the genus Novomessor into two groups. Novomessor *sensu strictu* received the species *albisetosus*, *cockerelli*, and *sonorae*, while the subgenus Veromessor was set up for *andrei*, *julianus*, *pergandei*, and *stoddardi*. Except for the addition of the species *chamberlini* and *relictus* to the subgenus Veromessor this was the plan followed by Emery in the Genera Insectorum (3).[1] Finally in 1922 (4) the senior author gave to Veromessor its present

[1] In Emery's paper of 1915 and also that of Forel in 1917 no descriptive matter of value for specific diagnosis appears. The various species are merely listed in each paper. This is also true of the listing in the Genera Insectorum. In order to simplify the synonomies of the various species references to the above listings have been omitted. They will be found in the bibliography at the end of the paper.

generic status. There is no reason to take up here the various phylogenetic considerations which have led to the groupings just considered. These will be presented in the discussion of each genus in the body of the paper.

NOVOMESSOR Emery.

Novomessor Emery, Rend. Accad Sc. Bologna, p. 73, (1915).
Forel, Bull. Soc. Vaud. Sci. Nat. Vol. 51, p. 235, (1917).

The genus Novomessor as defined in the present paper contains three species, *albisetosus* Mayr, *cockerelli* Ern. André, and *manni*, a new species described below. The authors are of the opinion that Pergande's species *sonorae* is a synonym of *cockerelli*. Both of these names were published in the year 1893, but since André's paper has precedence by several months, the name *cockerelli* has priority.

As has already been stated in the introduction, the genus Novomessor is related to Aphaenogaster. This relationship is so close that it is very unlikely that Novomessor could be confused with any other genus. We need, therefore, consider only the way in which the two differ. In presenting the structural criteria which distinguish them it is first necessary to make a qualifying statement in regard to Aphaenogaster. It happens that this genus is highly heterogenous in structure, a fact which makes comparison difficult. Nevertheless, with the exception of the Papuan subgenus Planimyrma, it is possible to make a generalization applicable to the remainder of the species. In the worker of Aphaenogaster the mesoëpinotal suture is always well developed. Moreover, the thoracic dorsum bears, at the suture, a distinct impression which is usually rather narrow. The result is to set off the epinotum sharply from the rest of the thorax. In the worker of Novomessor, on the other hand, the mesoëpinotal suture is entirely absent on the dorsum and upper parts of the sides of the thorax. All that is left of it is a short groove which does not extend above the level of the meso- and metapleurae. The dorsum of the thorax is unimpressed or, if an impression is present, it takes the form of a broad shallow concavity. The epinotum is, therefore, not sharply set off from the rest of the thorax as in Aphaenogaster. Oddly enough, the condition just described is also found in the thorax of the worker of Planimyrma.

While the thoracic differences outlined above are rather more subtle than one might expect in the case of two distinct genera they appear to be the only differential characters of any consequence. From a practical standpoint the large size of the worker and female

of Novomessor serves to distinguish them from any of the North American Aphaenogasters, but it is obvious, that this size difference has a limited application since there are other species of Aphaenogaster whose size more nearly approaches the size of Novomessor. In the case of the male caste the problem is even more difficult since the males of Novomessor are smaller than one would expect in view of the size of the female. The resemblance between these males and those of some of the more primitive species in the genus Aphaenogaster is so complete that the authors have been unable to discover any structural character peculiar to the males of the genus Novomessor. While this similarity bears out Emery's belief that Novomessor is a derivative of Attomyrma, it must be remembered that the species which at present make up the subgenus Attomyrma are by no means uniform in their degree of specialization. For this reason it is necessary to restrict the relationship of Novomessor to the more primitive species of Attomyrma, since a number of species belonging to Attomyrma show a degree of specialization considerably greater than that found in Novomessor. These advanced species (*gibbosa*, *spendida*, etc.) certainly cannot be regarded as an ancestral stock.

As Emery has shown,[2] there are several genera of xerophilous ants whose relationship can be traced directly to other genera which are not xerophilous. Thus Emery regards the Sonoran Myrmecocystus as a derivative of Lasius, the North African Cataglyphis as a derivative of Formica, and the Australian Melophorus as a derivative of the Plagiolepis group. It happens that all three of these xerophilous genera show ecological peculiarities and structural modifications that indicate a high degree of adaptation to desert life. This is not the case with Novomessor. There is little structural modification and practically no trophic adaptation which would mark them as well-developed xerophiles. This may best be explained on the assumption that Novomessor has only recently entered the desert areas which it now occupies. This does not mean, however, that Novomessor has had a recent origin. On the contrary, it appears to be an old group which has at some comparatively recent time been forced into desert areas through pressure from more highly developed forms.

It is fortunate that other problems connected with Novomessor are less vexing than the question of its phylogeny. Although far from complete our distributional records and ecological data give us

[2] Emery, Zool. Jahrb. Sup. 15, Band 1, (1912) p. 95 *et seq.*

a fair idea of the range and habits of the two northern representatives of the genus. The southern end of the range is at present Colima, Mexico, the type locality of the new species *manni*. It is to be regretted that so little is known of this species since it appears to be the most primitive member of the genus, and a better knowledge of its range and habits might throw light on the origin of the group. Since *manni* is known only from Colima and since nothing is known of its habits, our discussion of Novomessor must deal almost entirely with the two other species. As may be seen from the accompanying map the ranges of *cockerelli* and *albisetosus* are largely coextensive within the United States. *Cockerelli*, however, swings well to the south of *albisetosus*, specimens having been taken as far south as Zacatecas, Mexico. It may be noted that such southern specimens occur at higher elevations (7000 feet) than do those in the United States. The absence of Mexican records for *albisetosus* is puzzling, for it must certainly occur there as is indicated by its presence in the Chisos Mts., in southern Texas, which are only a few miles north of the Mexican border. To date, however, the locality just mentioned represents the known southern limit of the range of *albisetosus*. In the United States both species occur throughout a relatively narrow band which extends for approximately eight hundred miles from Del Rio, Texas, to Gila Bend, Arizona. In this area both nest on arid plateaus whose elevation varies from twenty-five hundred to five thousand feet. They do not as a rule descend below twenty-five hundred feet. Indeed their absence from the Mojave and Imperial Deserts appears to be due to their dependence upon elevation. To the casual observer *cockerelli* will appear to be the more abundant of the two, since it prefers to nest on the open plains, avoiding as a rule the isolated mountains which occur throughout its range. Its distribution is, consequently, more nearly uniform than that of *albisetosus*, since the latter usually founds its colonies in the foothills of the mountains and for this reason is absent over wide areas where *cockerelli* occurs in abundance. This difference in the choice of nest sites is not easy to explain. Certainly elevation has little or nothing to do with it. One of the few areas in which the two species occur together is the Davis Mts. in Texas. Here the nests are in close proximity and yet, even under these circumstances, there is apparently a difference in the choice of sites. The nests of *cockerelli* are usually found in the level land near the stream bottoms while those of *albisetosus*, as a rule, occur on the sloping lower flanks of the

FIGURE 1. Map showing the distribution of Novomessor and Veromessor. The locality records for two species in each genus are indicated as follows: *N. albisetosus* ●, *N. cockerelli* ▲, *V. andrei* ○, *V. pergandei* ■. The probable ranges of the two genera are indicated by cross-hatching as follows: Veromessor [▨], Novomessor [▨].

hills. Since the nests of the two species are frequently less than a mile apart and practically at the same elevation it is difficult to believe that in this case altitude could influence the choice of nest sites.

It is unlikely that anyone who has seen the nests of these insects could have failed to be impressed with their extraordinary coarseness of construction. There is not a single feature of the nest which does

not appear abnormally large in view of the size of the insects themselves. The irregular central opening of the nest may be three or four inches across. Through this one looks down into a steeply descending, roughly constructed tunnel which more nearly resembles a rat's burrow than the entrance to an ant's nest. Around the central opening the insects ordinarily build a disc of very coarse gravel mixed with excavated soil. This disc may be six feet in diameter in the nests of *cockerelli*, but is usually smaller and sometimes absent in the nests of *albisetosus*. Towards the center of the disc there is often a thicker pile of soil and gravel which has been formed into a rude crater. Those nests of *albisetosus* which lack the disc and crater are generally constructed under stones but otherwise do not differ from the nests of the more common type.

During the summer months the foraging activities of these insects begin late in the afternoon and continue through the night hours. In the summer of '33 the junior author was able to observe the nocturnal activities of both species since each came regularly to collect small insects attracted to the camp light. As a rule by the middle of the morning the workers have returned to the nest where they remain during the midday hours. When foraging the workers do not form files. Each stalks slowly about in a deliberate manner, which gives it a ludicrous air of bland solemnity. It may be doubted if these insects are capable of quick movement since, even when disturbed, their best efforts at speed are neither rapid nor sustained. The workers show no particular preference for seeds since, in addition to these, they gather small bits of plant tissue, pieces of fruit, and the disarticulated parts of insects. The latter are probably secured from insects which are dead or in a moribund condition since the slow movements of Novomessor would scarcely permit successful predatism. Little if any of the various substances brought into the nest are stored there. It seems scarcely necessary to add that insects with such generalized feeding habits can scarcely be considered harvesters. It is possible to go one step further and question whether the ants of the genus Novomessor, despite their distribution, ought to be regarded as highly adapted xerophiles. Since trophic specialization of one sort or another is such a regular occurrence among the highly xerophilous species, its absence in a desert-dwelling group, such as Novomessor, can scarcely be without significance. The idea that Novomessor is not well adapted to desert life finds support in the character of the ammochaetae which these insects possess. As has been

pointed out by the senior author (5), the presence of these groups of hairs in an almost invariable feature among forms well adapted for desert life. This correlation is readily understandable when one considers that the ammochaetae are used to carry excavated dust or sand out of the burrows, a function which is particularly important in the case of desert-dwelling forms. The ammochaetae of the three species of Novomessor form an interesting developmental series. In *manni* the scattered hairs of the gula and mentum are scarcely longer than those on the other parts of the body. It cannot be said that this species possesses anything which could be called ammochaetae. In *cockerelli* some of the gular hairs are of fair length and recurved at the tip, but most of the hairs on the lower surface of the head are no longer than those elsewhere. There is no linear arrangement, as for example in Pogonomyrmex, of the long hairs which are scattered at random over the whole under surface of the head. In *albisetosus*, in which there are definite though poorly developed ammochaetae, the majority of the long hairs are segregated towards the sides of the head and, in addition, there are hairs along the lower surface of the mandibles. Of the three species there can be no question that *albisetosus* is the most specialized so far as ammochaetal development is concerned. Even so, its ammochaetae are far inferior to those of many xerophilous species and do not form what Santschi has called a "psammophore."

The workers of the three species of Novomessor may be separated by means of the following key:

1. Occiput prolonged posteriorly into a triangular neck which terminates in a distinct flange. . . . . *manni* sp. nov.

   Occiput not prolonged posteriorly, the occipital border flat in the middle or slightly convex, the occipital angles well marked. 2

2. Head, exclusive of the mandibles, very slightly or not at all longer than broad, with wavy longitudinal rugae extending almost to the occipital border, the latter granulose. . . . . *albisetosus* Mayr

   Head, exclusive of the mandibles, at least one and a third times as long as broad, with the wavy longitudinal rugae well developed only on the anterior half of the head, the posterior half with much feebler rugae, which are replaced toward the occiput with fine coriaceous sculpture. . . . . *cockerelli* Ern. André.

Novomessor albisetosus (Mayr.)

(Plate I, fig. 3).

N. albisetosus (Mayr), Verh. Zool-bot. Ges. Wien, Vol. 36, pp. 443, 446 (1886) (Aphaenogaster).
Wheeler, Ants, p. 280, (1910).

This species is so well known and so easily recognized that a detailed description seems superfluous. That there could be any confusion of *albisetosus* with *manni* seems very unlikely since the unique head of the latter sets it off sharply from the other forms. The differences shown by *albisetosus* and *cockerelli*, on the other hand, while quite distinct are less obvious. Since these species are those ordinarily met with in collections, it seems advantageous to amplify the brief diagnostic remarks of the key by a more careful comparison.

As has been noted in the key, the head of *albisetosus* is shorter than that of *cockerelli*. There is also a difference in shape. In *albisetosus* the sides of the head in front of the eyes are subparallel but behind the eyes become convex, merging without an abrupt transition into the broadly rounded occipital angles. The posterior border of the head consequently appears evenly convex or if the median portion of the occipital border is flattened this flattening is not extensive. In *cockerelli* the sides of the head are feebly convex throughout and, since the occipital angles are much less rounded, the border of the occiput presents a broad flattened median portion which is bordered behind by a narrow flange.

In thoracic structure the two species are rather similar, except for the epinotal spines. In *albisetosus* these are at least as long as the basal face of the epinotum. In *cockerelli* they are considerably shorter. The other differences shown by the epinotal spines are less constant, but in most cases those of *albisetosus* are more nearly straight and more divergent than those of *cockerelli*. In *albisetosus* if the spines are bent at all the curve is downward, whereas in *cockerelli* the spines are ordinarily bent inward so that when seen from above they appear subparallel.

The most striking sculptural difference in the two species has already been noted in the key. In addition *albisetosus*, because of its heavier sculpture shows a uniformly greater degree of opacity than *cockerelli*. This is particularly noticeable in the case of the petiole which is almost completely opaque in *albisetosus* while in *cockerelli* at least the node and usually the lower portions as well are very shining. There is a good deal of variation in the cephalic sculp-

ture of *albisetosus* since in certain specimens the rugae proceed to the occipital border without being bent toward the center of the head. At the other extreme are those individuals in which the rugae turn inward sharply a short distance behind the eyes. In these the vertex is covered with prominent transverse rugae while the occiput is largely granulose. Although this difference is marked it is not constant and cannot be used as a basis for subspecific distinction.

Albisetosus is also much more hairy than *cockerelli*. In the former species the entire body is covered with numerous coarse whitish-yellow hairs. These taper from base to tip but are rather blunt particularly those on the epinotum and petiolar nodes. The cephalic hairs, which are abundant on the upper surface and sides of the head, are very variable in length. Those on the dorsum of the pro- and mesonotum are more uniform and of a length approximately equal to the longest cephalic hairs. A few short hairs occur on the epinotum and the petiolar nodes. The abdomen bears numerous hairs of quite uniform length but shorter than those of the pronotum. These abdominal hairs are most numerous on the posterior segments, thinning out toward the base of the postpetiole. In *cockerelli*, with the exception of two or three long hairs on the front of the head and a group on the ventral surface of the abdominal segments, the pilosity is uniformly short. It is also notably sparser in *cockerelli*. This difference is most noticeable on the upper surface of the gaster, which in *cockerelli* is entirely covered with evenly spaced hairs. Because of their shortness and infrequent occurrence these do not overlap like the gastric hairs of *albisetosus*.

The females of the two species may be separated easily on the basis of cephalic structure. The head of the female of *albisetosus* is only slightly longer than broad (mandibles excluded), with antennal scapes which in repose surpass the occipital border by a distance not exceeding the length of the first funicular joint. In most specimens the sides of the head taper inward from the mandibular insertions to the anterior border of the eyes but, even when this constriction is not well marked, the part of the head anterior to the eyes is noticeably narrower than the part behind them. In the female of *cockerelli* the head is decidedly longer than broad. No constriction of the anterior part of the head occurs and the sides of the head are straight or very feebly convex. The scapes in repose surpass the occipital border by a distance exceeding the length of the first funicular joint.

An additional and very striking difference between the females of

these two species is furnished by the thoracic structure. The entire thorax of the female of *albisetosus* is shorter and higher than that of *cockerelli*. The difference is most conspicuous in the epinotum. In *albisetosus* this region is so short that the basal and declivous faces meet at a very wide angle which might be considered a single sloping surface, were it not that the angular bases of the epinotal spines still preserve to some extent the point of junction. In *cockerelli*, since the epinotum is longer, the basal face is much less sloping and meets the declivous face at a well-marked angle.

In the female the differences in sculpture and pilosity are much less striking than in the worker, although distinctions do exist, notably the much more shining epinotum in the case of *cockerelli*. On the other hand, the head of the female of *cockerelli* is entirely rugose and it is considerably more hairy than the worker so that distinctions based upon sculpture and pilosity are of less value than in the case of the worker.

The males of *cockerelli* and *albisetosus* may also be readily distinguished. The somewhat smaller (6 mm.) male of *albisetosus* has a short head with the ocelli borne well back toward the occiput, which slopes strongly just behind them. Viewed from the side the two posterior ocelli mark an angle separating the occipital area from the front. The mesonotum of the thorax is covered with weak rugae, granulate and feebly shining, except for a narrow, strongly shining, median strip which extends entirely across the anterior half of the scutum. The notauli are indistinct. The male of *cockerelli* is larger (7.5 mm.), the head is much longer and there is no marked angle between the occiput and the front, the ocelli occurring well down on the head. The thorax is bulkier and more feebly sculptured, with a large shining triangular area on the scutum between well marked notauli.

No exact type locality is available for *albisetosus*. Mayr notes that the two specimens from which this species was originally described were taken by Norton in New Mexico. We have seen material from the following localities:

Texas: Alamito, Presidio Co. (W. M. Wheeler.)
Chisos Mts. (O. W. Williams and W. S. Creighton.)
Ft. Davis Mts. (W. M. Wheeler, J. C. Bradley and W. S. Creighton.)
Presidio. (W. C. McDuffie.)
New Mexico: Lordsburg. (Cornell Univ. Exp.)

New Mexico: Steins. (W. M. Wheeler.)
Arizona: Baboquivari Mts. (No collector.)
Bisbee. (L. C. Murphree.)
Bonita, Graham Co. (J. C. Bradley.)
Coyote Mts. (No collector.)
Globe. (H. C. Markman.)
Huachuca Mts. (W. M. Wheeler and W. S. Creighton.)
Nogales. (Oslar and L. C. Murphree.)
Oracle. (W. M. Wheeler.)
Pinaleño Mts. (W. M. Wheeler.)
Texas Pass. (W. M. Wheeler.)

Novomessor cockerelli (Ern. André).

(Plate I, figs. 1 and 4.)

N. cockerelli (Ern. André), Rev. Ent. p. 150 (1893) (Ischnomyrmex).
Wheeler, Ants, pp. 273, 280, fig. 155 (1910).
N. sonorae (Pergande) Proc. Calif. Acad. Sci. (2) Vol. 4, p. 34 (1893) (Aphaenogaster).

The characteristics by means of which all three castes of this insect may be recognized have been given in the discussion of *albisetosus*. The habits of *cockerelli* have also been taken up in a previous paragraph. We shall, therefore, merely add the locality records for this species. The type locality is Montezuma, Chihuahua, Mexico (T. D. A. Cockerell). We have seen specimens from the following localities:

Arizona: Benson. (W. M. Wheeler.)
Fenner Canyon, Santa Catalina Mts. (W. M. Wheeler.)
Florence. (C. D. Lebert.)
Gila Bend Mts. (W. M. Wheeler.)
Hereford. (W. M. Wheeler.)
Huachuca Mts. (C. R. Biedermann.)
Oracle, Tempe, Tucson, and Yucca. (W. M. Wheeler.)
New Mexico: Aden. (W. M. Wheeler.)
Alamogordo. (G. von Krockow.)
Lordsburg. (W. S. Creighton.)
Steins. (W. M. Wheeler.)
Texas: Alpine. (W. M. Wheeler, W. S. Creighton.)
Del Rio. (W. M. Wheeler.)
El Paso. (P. J. Darlington, J. C. Bradley.)

Texas: Ft. Davis Mts. (W. M. Wheeler, J. C. Bradley, W. S. Creighton.)
Ft. Stockton. (W. M. Wheeler.)
Juno. (J. C. Bradley.)
Langtry. (W. M. Wheeler.)
Marathon. (W. S. Creighton.)
Monahans. (W. M. Wheeler.)
Sierra Blanca. (W. S. Creighton.)
Terlingua and Toronto. (W. M. Wheeler.)
Warfield. (W. S. Creighton.)
Mexico: Cerro Carrizal, Chihuahua. (C. H. Townsend.)
Pacheco, Zacatecas. (W. M. Wheeler.)

Novomessor manni sp. nov.

Worker: Length 10 mm. (Plate I, fig. 2.)

Head, exclusive of the mandibles, slightly less than twice as long as broad, widest just behind the eyes, the sides of the anterior half straight and only slightly tapering inward from the eye to the insertion of the mandibles; posterior to the eyes they are feebly convex and converge sharply toward the occiput where they form a flanged collar similar to that in certain species of Aphaenogaster (*araneoides* etc.). Clypeus rather flat above, truncate anteriorly with the lateral edges feebly arcuate. Mandibles large, triangular, with three apical teeth, the innermost tooth notably smaller and more obtuse than the other two, the remainder of the masticatory margin irregularly serrate but without definite denticles. Eyes prominent, strongly convex, subcircular in outline, placed slightly in front of the middle of the head. Frontal carinae well developed, strongly divergent anteriorly, parallel behind. Frontal area well defined, slightly but clearly depressed. Antennal scapes feebly curved, their thickness evenly increasing from base to tip. In repose they surpass the occipital margin by a distance equal to one quarter of their entire length. Funiculus filiform, the first joint much longer than any of the succeeding joints, which notably decrease in length though only slightly increasing in thickness from base to apex.

Thorax without sutures. Seen from above the pronotum is campanulate and twice as wide as the immediately adjacent portion of the mesonotum. Sides of the mesonotum moderately divergent behind, slightly wider than the epinotum, the latter narrowed in front but rectangular behind. Seen in profile the promesonotum

forms a single feeble and somewhat irregular convexity, the epinotum is flat throughout except for an anterior sinuosity where it joins the mesonotum. Epinotal spines long, their apical two-thirds slender, their bases somewhat thickened. Seen in profile they are virtually straight and almost parallel with the dorsum of the epinotum. Seen from above they are feebly divergent and slightly curved inward, with their thickened bases set close together.

Node of the petiole in profile low and evenly rounded above, its anterior face meeting the thick and tapering anterior peduncle in a well-marked angle, its posterior face confluent with the short posterior peduncle. Postpetiole in profile much narrowed in front, the dorsum feebly convex, the ventral surface straight in its anterior half and feebly sinuate behind. Seen from above the node of the petiole is suboval, scarcely wider than the peduncle, and less than half as wide as the pyriform postpetiole. Gaster large, oval.

Head and thorax ferruginous; petiolar nodes, epinotal spines, and legs clear yellowish red; antennal scapes and to a lesser extent the funiculi sordid, reddish brown; abdomen piceous brown. Mandibles shining, with feeble striae and numerous, coarse, piligerous punctures. Clypeus with a few, coarse, longitudinal striae which converge at its anterior edge. Head with numerous, coarse, wavy rugae extending diagonally from the genae across the front and uniting to form continuous, sharp, transverse rugae on the vertex. Area just behind the frontal carinae with longitudinal rugae. The spaces between them on the front and vertex are granulose, giving this portion of the head a duller appearance than elsewhere. Entire thorax strongly shining, the pronotum feebly shagreened; mesonotum and epinotum with prominent transverse rugae. Area between the base of the epinotal spines smooth. Petiole and postpetiole finely granulose, dull. Gaster smooth and very shining with sparse and minute, piligerous punctures. Hairs golden, sparse, short, stout, erect, or suberect; virtually absent on the mesonotum and epinotum, no longer on the under surface of the head than elsewhere. Tarsi and scapes covered with numerous rather fine, suberect hairs; funiculi pubescent.

Described from a single worker taken by Dr. W. M. Mann at Colima, Mexico.

VEROMESSOR Forel.

Veromessor Forel, Bull. Soc. Vaud. Sc. Nat. Vol. 51, p. 235, (1917) (Novomessor subgenus).

Veromessor Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 45, p. 661, 680, (1922).

As ordinarily defined the genus Veromessor contains seven species, *andrei*, *chamberlini*, *julianus*, *lobognathus*, *pergandei*, *relictus* and *stoddardi*. All of these have been previously described and no new species are added in the present paper. Dr. W. M. Mann has, however, been fortunate in discovering two new variants of *julianus* and the senior author two which belong to *andrei*.

It is difficult to make general statements which will apply to the genus Veromessor since its members vary widely in structure, habits, and faunistic affinities. These differences appear to be due to the long isolation of the various species, an isolation which must date back to the Cretaceous period to judge from the presence of *relictus* in Haiti. Since it is impractical to treat the genus as an ecological or zoögeographical unit, we have confined the introductory discussion to a consideration of those characteristics which have to do with the phylogeny of the group. This last is a matter badly in need of clarification. To date, the only attempt to explain the phylogenetic relationships of the genus Veromessor is that made by Emery in the Genera Insectorum (3). It has already been mentioned that in this publication Emery treated Veromessor as a subgenus of Novomessor. For this reason his phylogenetic considerations were applied to the entire group, a fact which now makes them confusing rather than helpful because of the subsequent separation of the two genera. However, if Emery's conception is to be considered at all, we must assume that his derivation was intended to apply to both genera. This being true, the authors cannot agree with Emery's ideas concerning the origin of the genus Veromessor. In his introductory statement on the genus Novomessor he wrote as follows: "This genus constitutes a group parallel to Messor in the new world but it is not derived from Messor nor is the reciprocal true. In my opinion Novomessor has had an independent origin and is descended from some species of Attomyrma which adapted itself to a graminivorous diet; in any case Messor cannot be derived from Novomessor because of the venation of the wings, which is more primitive in the former group." It is not difficult to show that Emery's derivation of Veromessor from Attomyrma is unsound. The structure of the males in the two groups presents what appears to be unquestionable evidence that Attomyrma cannot be ancestral to Veromessor. Among the more highly specialized genera in the tribe Pheidolini the males possess certain structural features of an advanced type. This is particularly apparent in the males of Aphaenogaster, Pheidole, and

Ischnomyrmex. In many of the species belonging to these genera the head of the male is undergoing a reduction in size which results in a shrinkage of the occipital margin behind the lateral ocelli, which, instead of being borne on the front, form a projecting crown at the top of the head, where the sides slope outward to the insertion of the mandibles. In addition there are thoracic alterations. The scutum has been enlarged at the expense of the other thoracic sclerites and this has resulted in the formation of a large overhanging bulge at the anterior edge of the scutum. The small pronotum is forced downward under the scutum and in extreme cases appears to lie on the ventral surface of the thorax. Either or both of these peculiarities may appear in the same insect. When both are well developed the result is apt to be rather incongruous, since there is produced a male whose absurdly small head is attached at a point on the thorax where one would expect to find the front coxae. On the other hand, the males of the more primitive Pheidolini do not show the configuration just described. This is particularly true of the males of Messor, in which the head is elongate, with subparallel sides, well-marked occipital angles, and the lateral ocelli borne well forward of the occipital margin. In the thorax the scutum only slightly overhangs the pronotum and is not disproportionately swollen. If Veromessor has been derived from Attomyrma as Emery postulates, we should certainly expect it to have males possessing the characteristics of the Aphaenogaster type. Actually the males of Veromessor are very similar to those of Messor. This is particularly true of the male of *pergandei*. The males of Veromessor must, therefore, be regarded as more primitive than those of Attomyrma.

While it is easy to demolish Emery's hypothesis, it is very difficult to replace it with another which cannot be questioned. Lack of adequate paleontological data for most of our Formicid genera reduces any discussion of phylogeny to a highly speculative and opinionated process. In the ensuing paragraphs the authors have attempted to show that Veromessor is a derivative of Messor. It must be admitted, however, that in the last analysis this derivation is based upon probabilities rather than facts.

If we compare a worker of *pergandei* with one of equal size belonging to *Messor barbarus* their striking similarity is obvious. Indeed, if in this comparison we select the subspecies *aegypticus*, the point for point resemblance of the two forms is astonishing. While it is true that the worker of *pergandei* has eyes of a different shape, somewhat

sharper epinotal spines, feebler thoracic sculpture, more numerous hairs, and a deeper color, all of these differences, except perhaps the first, are within the latitude allowed for subspecific or varietal aberrations. One can scarcely avoid speculation as to the status which would have been accorded to *pergandei* had it chanced to occur in the Mediterranean basin instead of the southwestern United States. Additional parallelism is evident in the ecological stations and habits of the two genera.

A consideration of the distribution of the genus Messor shows that it occurs in the greatest abundance in those portions of Africa and Asia Minor which border the Mediterranean. A branch follows up the valley of the Nile, swinging across central Africa, and extending southward to the Cape of Good Hope. Another gets into the Balkans and southern Russia. Still another passes across Turkestan and northern India into China. Since the climatic conditions throughout this enormous area vary widely, it is difficult to make any satisfactory generalization concerning the relationship of Messor to climate. However, one may safely assert that wherever it occurs the genus Messor, with the exception of the East Asian species *aciculatus*, shows a marked preference for high temperatures and aridity. This is well shown by the studies of Doflein (6), who observed the activities of these insects in Macedonia where he found the workers of *M. barbarus* actively foraging during the hottest hours of the day in the months of July and August. At that time the heat was sufficiently intense to drive the workers of the other species to the shelter of their nests. Despite its marked thermophily there is apparently an upper temperature limit for *barbarus*. According to Escherich, who observed this insect in Erytrea, it is crepuscular and nocturnal in habit. Needless to say this does not negate the thermophily of *barbarus*, since its presence in the parched deserts along the Red Sea indicates a strong preference for high temperature. This preference or tolerance can only mean that *barbarus* is well adapted to desert life, a conclusion further borne out by its seed-storing habit and the well-developed psammophore in most of the forms. There is every reason to believe that *barbarus* is a xerophile of long standing. Since it is definitely adapted to excessive temperatures, it seems surprising that in Asia proper it avoids the great desert of western India. The relatively few records of this insect from India all come from the northwestern Himalayas. From this point eastward there are virtually no records of the genus until one reaches eastern China where *aciculatus* occurs.

There can be little doubt that this break is occasioned by inadequate field work rather than the absence of the genus, since the area traversed is in the almost unknown region of eastern Turkestan and Tibet. *M. aciculatus*, the most eastern representative of the genus Messor, shows a number of differences when contrasted with *barbarus*. The most obvious of these is structural since *aciculatus* possesses monomorphic workers and hence may be considered to be less specialized than *barbarus*. While very little has been published on the ethology of *aciculatus*, the available data seem to show that it is unquestionably less xerophilous than the circummediterranean species. It usually nests in areas which are capable of cultivation, apparently preferring these to desert conditions. Its known range extends from Foochow north to Peking. In terms of latitude this represents a north to south distribution from Lat. 40° to Lat. 25°, which is almost identical with the Mediterranean portion of the range of *barbarus*. It must be borne in mind, however, that the climatic conditions in eastern China are influenced by the Kamchatka Current and that, for this reason, the area in which *aciculatus* occurs shows a lower average yearly temperature than the corresponding portion of the range of *barbarus*. That *aciculatus* should be less thermophilous and less xerophilous than the other species of Messor appears to the authors to be a fact of considerable significance.

Let us now turn our attention to the genus Veromessor. In the sun-baked deserts of western Arizona and southern California we find *V. pergandei*. In these areas the midday temperatures during the summer months usually run in the neighborhood of 116° F., and temperatures of 130° are not unknown. Despite the terrific heat and glare of the sun, *pergandei* workers forage actively in the middle of the day during the greater part of the summer. It is perhaps too much to say that they are never affected by the heat, but it is true that they are kept in the nest only by temperatures of unusual intensity. Like *M. barbarus*, *pergandei* collects and stores seeds and has a beautifully developed psammophore. We must, therefore, regard it as a highly xerophilous species which has probably existed in the deserts over a very long period.

Adjacent to the extreme western part of the range of *pergandei* we find another species, *V. andrei*. Its known range extends from San Diego almost to the Oregon border. In the southern portions of this range the climatic conditions are, of course, often hot and arid. However, since *andrei* prefers the western slopes of the Coast Range,

where the winds from the Pacific mitigate both temperature and dryness, even the extreme southern portions of its range are less hot and arid than the areas in which *pergandei* occurs. As for the portion of the range of *andrei* which lies in northern California little need be said. Whatever zonal interpretation may be placed upon the valleys lying between the mountains of the Coast Range, it is certain that their mean yearly temperature is notably lower and their precipitation much higher than in the great Sonoran areas farther to the south. One may, therefore, question whether *andrei* is a very xerophilous species, and, if it is included in such a category, it is necessary to make strong qualifications concerning its response to temperature and moisture. Moreover, *andrei* further differs from *pergandei* in the character of the worker caste. The workers of *andrei* are monomorphic or very feebly polymorphic and for this reason it must be considered less specialized than *pergandei*.

To summarize the data just presented one may state that in both Messor and Novomessor we find the more specialized species completely xerophilous and living in areas of unusually high temperature. Each genus, however, contains a less specialized form which is less xerophilous and whose range lies in an area of lower temperature.

As has already been stated, the facts just presented are open to several explanations. Since the two genera are separated by the enormous territory which extends from northern China through Siberia and Alaska into Canada and the northwestern United States, one may defend the view that they have nothing in common and that the similarities just discussed are cases of convergence without phylogenetic significance. On the other hand, it must be borne in mind that the area which now separates the two is one of the few great intercontinental migrational pathways whose existence has never been disputed. The statement that in past periods the genus Messor might have utilized the Siberian-Alaskan land bridge certainly offers no novelty when compared with our customary beliefs on migration in this area. In view of the marked xerophily and thermophily of some of the forms in each genus our hypothesis necessitates a very different climate for Siberia and Alaska if Messor has ever been present in those areas. There is no reason why this may not have been true, since there is ample evidence to show that at several periods prior to the Pleistocene the climate of the Northern hemisphere was tropical or subtropical in character. We assume that during one of these periods of warmth the range of the genus Messor extended through north-

eastern Asia and northwestern North America. The subsequent isolation of the North American representatives of this original stock through climatic change has resulted in the development of the separate characters which mark the present genus Veromessor.

This assumption would be considerably strengthened by paleontological evidence of the genus Messor in the New World. Dr. Carpenter, in his interesting monograph of the fossil ants of North America, (7) records *Messor sculpturatus* from the Florissant shales. This insect, described from female specimens, was placed in the genus Messor because the fore wing has two cubital cells. Dr. Carpenter assumed, therefore, that it cannot be included in the genera *Novomessor* or *Veromessor*.

Through the courtesy of Dr. Carpenter, the junior author has examined the holotype and several other specimens of *M. sculpturatus*. As Dr. Carpenter has noted in his original description, the holotype is rather faint. Nevertheless certain details of the sculpture have been clearly preserved. Thus it may be seen that the antennal scapes and the abdomen are striate. Not all the abdominal striae have been preserved but those which are present appear as beautifully regular, fine, parallel lines. Unfortunately similar conditions of sculpture do not occur in the present day species of the genus Messor and, more unfortunately still, they do occur in some of the South American species of Pogonomyrmex. Although it would be extremely gratifying to have paleontological proof of the presence of Messor in North America, there seems to be more reason for regarding Dr. Carpenter's *sculpturatus* as a Pogonomyrmex. For the present, therefore, we have no conclusive proof of the origin of the genus Veromessor. The following key presents characters by which the workers of the various forms may be recognized:

Key to the genus Veromessor.

1. Head coarsely reticulo-rugose or with wavy longitudinal rugae, the interrugal spaces coriaceous or granulose 6

   Head covered with fine, longitudinal striae which are interrupted by punctures 2

2. Epinotal spines short, their length not exceeding the distance separating their bases 3

   Epinotal spines long, their length twice as great as the distance separating their bases 4

3. Dorsum of the pronotum without sculpture, shagreened, and strongly shining, color black or piceous brown ..... *pergandei*

   Dorsum of the pronotum longitudinally striate, feebly shining, color reddish brown ..... *stoddardi*

4. Dorsum of the thorax not impressed at the mesoëpinotal suture, thorax blackish red, abdomen piceous black ..... *julianus*

   Dorsum of the thorax strongly impressed at the mesoëpinotal suture, thorax reddish yellow, abdomen brown with a yellow spot at the base of the first segment 5

5. Hairs on the abdomen numerous and regular in arrangement, length of insect 6.5 mm ..... *julianus* subsp. *clarior*

   Hairs of the abdomen sparse and irregular in arrangement, length of insect 4.5 mm ..... *julianus* subsp. *manni*

6. Head coarsely reticulo-rugose, the first gastric segment strongly granulose and completely opaque 7

   Head with wavy longitudinal rugae, the entire gaster strongly shining at most microscopically shagreened 8

7. Basal face of the epinotum in profile straight or very feebly and evenly convex, epinotal spines slightly curved downwards ..... *relictus*

   Basal face of the epinotum in profile more strongly convex, with a pronounced median impression, epinotal spines straight. *relictus* subsp. *epinotalis*

8. Rugae along the midline of the head fine, approximately straight and not diverging behind; the interrugal spaces over the entire head strongly coriaceous, dull ..... *lobognathus*

   Rugae along the midline of the head coarse, wavy and diverging behind; the interrugal spaces granulose and feebly shining 9

9. Proximal portion of the antennal scape ending in a trumpet-like expansion; head longer than broad 10

   Proximal portion of the antennal scape ending in a flattened, spatulate area; head as broad as long ..... *chamberlini*

10. Antennal scapes in repose just reaching the occipital border; color blackish red to clear red ..... *andrei*

    Antennal scapes in repose slightly surpassing the occipital border, color castaneous or flavous 11

11. Color castaneous brown; sculpture of head and thorax strong, shining. *andrei* subsp. *castaneus*

    Color flavous yellow; sculpture of head and thorax rather feeble and dull ..... *andrei* subsp. *flavus*

Veromessor andrei (Mayr.)

Veromessor andrei (Mayr), Verh. Zool-bot. Ges. Wien, Vol. 36, p. 443, 448 (1886) (Aphaenogaster) ♂.

Stenamma (*Messor*) *andrei* Emery, Zool. Jahrb. Syst. Vol. 8, p. 306 (1895) ☿.

Worker: Length: 4.5–7 mm. (Plate II, fig. 2.)

Head, exclusive of the mandibles, four-fifths as broad as long, slightly wider behind the eyes than in front of them, the sides in front of the eyes straight, behind the eyes slightly convex and meeting the occiput in a broadly rounded angle. Occipital border with a broad though very shallow median concavity. Border of the clypeus straight or at most very feebly convex, the median portion feebly sulcate, the lateral portions raised into a narrow ridge or welt which bounds the anterior edge of the antennal fossa. Frontal area opaque. Frontal carinae very narrow and welt-like, slightly divergent above the insertion of the scapes, much more divergent posteriorly where they fuse with the sculpture of the head at a point just behind the posterior border of the antennal fossae. Eyes of moderate size, oval in outline, strongly convex, with about sixteen facets in their greatest diameter, their posterior border lying at a point half way between the insertion of the mandible and the occipital border. Antennal scapes slender, the proximal portion dilated to form a trumpet-shaped expansion, distal to this the median portion of the scape somewhat constricted, the apical end only slightly swollen and no larger in diameter than the flared proximal end. When in repose the tip of the scape just reaches the occipital border. Funicular joints, with the exception of the last three, all longer than broad, especially the first joint, which is more than twice as long as broad; joints ten and eleven only slightly longer than broad and notably thicker than the preceding joints, the terminal joint bluntly pointed, longer but no thicker than the preceding two. Mandibles large and stout with the evenly curved outer edge meeting the masticatory margin in a powerful two-cusped terminal tooth. The remaining six or seven teeth much smaller, forming a concave serrated edge to the masticatory margin, the latter meeting the straight inner margin of the mandible at a right angle.

Thorax, seen in profile, with a gibbous promesonotum, the promesonotal suture marked by a somewhat flattened area but not forming a distinct depression; epinotum greatly depressed, the mesoepinotal suture broad and strongly impressed; basal face of the epinotum virtually flat, sloping slightly backward, terminating in two

large, straight, divergent spines, which slightly exceed the length of the basal face of the epinotum; declivous face of the epinotum short and concave. Seen from above, the promesonotum is pyriform and notably wider than the rest of the thorax, the sides of the thorax very slightly constricted at the mesoëpinotal suture, sides of the epinotum virtually parallel. First joint of the petiole with a rather thick peduncle, which gradually increases in thickness from its anterior end to the base of the node, its ventral surface with a sharp anterior tooth and a low, rounded lamella at its midpoint. Node of the petiole small, its height no greater than the thickness of the peduncle, its anterior face forming a continuous feebly concave slope with the dorsum of the peduncle, the summit acute, the posterior face very declivous and strongly convex, posterior peduncle extremely short. Postpetiole in profile lower than the petiole, the node low and rounded above, with the anterior face longer though less declivous than the posterior face, ventral surface with a prominent V-shaped median impression. Seen from above, the rather narrow petiole is scarcely two-thirds as wide as the campanulate postpetiole. Gaster large. Legs long, the femora slightly swollen.

Head subopaque, completely covered with rather coarse, wavy rugae which diverge toward the occiput. The interrugal spaces finely granulose and feebly shining. Mandibles shining, with moderately prominent longitudinal striae. Antennal scapes feebly granulose, more shining than the head. Thorax somewhat more opaque than the head, completely covered with irregular rugae, except at the front and lateral edges of the pronotum where they are subparallel. Petiole and postpetiole strongly granulose, with a few short rugae. Gaster smooth and shining, with numerous fine piligerous punctures.

Entire insect covered with glistening whitish hairs which are very unequal in length; the gular hairs forming rather poorly developed ammochaetae, longer than the majority of hairs on the head and thorax but almost equalled in length by a few long hairs which occur on the upper surface of the head, the pronotum, and the coxae of the fore legs. Dorsum of the first gastric segment entirely covered with hairs which are relatively short and more nearly of equal length than those on the head and thorax. Hairs on the remaining abdominal segments confined to the posterior border of each segment. Antennal scapes, femora, and tibiae with numerous, short, erect hairs; those on the tarsi somewhat finer and subappressed; funicular hairs very fine, short, and subappressed, except on the last four joints where they are replaced by golden pubescence.

Color variable. In some specimens the entire insect is reddish black, except for the nodes of the petiole which are reddish. In other specimens only the posterior part of the gaster is black, the first gastric segment castaneous and the remainder of the insect clear, deep red. Not infrequently both the head and gaster are infuscated, leaving only the thorax and nodes of the petiole red.

In his original description Mayr merely notes that the types came from California. We have seen material from the following localities:

California: Antelope, Sacramento Valley. (C. D. Cook.)
Berkeley. (W. M. Wheeler.)
Claremont. (C. F. Baker.)
Descanso. (No collector.)
Edendale. (J. C. Bradley.)
Eldridge. (J. A. Kusche.)
Laguna Beach. (E. O. Essig.)
La Jolla. (W. M. Wheeler.)
Palo Alto. (H. Heath and Miss Isabel McCracken.)
Perris. (J. C. Bradley.)
Point Loma. (W. M. Wheeler.)
Ramona. (J. C. Bradley.)
Riverside. (H. L. Quayle.)
Santa Catalina Island. (C. F. Baker.)
San Diego. (W. M. Wheeler.)
Santa Isabel. (No collector.)
San Isidro. (W. M. Wheeler.)
San Jacinto. (No collector.)
Tejon Pass. (W. M. Wheeler.)
Weaverville. (W. S. Creighton.)
Whittier. (J. C. Bradley.)
Nevada: Ormsby. (C. F. Baker.)
Mexico: Coronado Island. (C. T. Brues.)

As may be seen from the locality records just presented, the known range of *andrei* lies almost entirely in California but, since it has been taken as far north as Weaverville, there is good reason to suppose that it also occurs in Oregon. On the other hand, while it must certainly occur in continental Mexico, it is doubtful whether its range extends much below the southern boundary of California, since it has never been taken by collectors in Lower California. It is apparently replaced in this area by *julianus*. As has already been

mentioned, *andrei* nests in the foot hills of the Coast Range. Although built in open areas the nests are not particularly conspicuous. There is usually no crater, but the nest entrance is surrounded by an area of gravel which, because of its irregularity, can hardly be called a disc. The workers forage in files and collect seeds which are apparently stored in the nest, to judge from the chaff which surrounds the nest entrance. This chaff is scattered about and not formed into a crescent or ring as in the case of *pergandei*.

Very little is known of the mating habits of *andrei*. Sexual forms which we have examined have been collected from June to September 15. In view of the occurrence of the species in the northern part of California, it seems likely that the marriage flight takes place early in the spring.

The color variations which occur in *andrei* are very perplexing. While it cannot be denied that it is possible to select specimens which show a very pronounced difference in color, the junior author is convinced that these variations are not suitable for varietal separation. Their inconstancy within the colony is such that there can be little doubt that they are merely nest varieties. Nevertheless, there appears to be a certain amount of correlation between the color of the insect and its geographical distribution. In general it is true that colonies from the more southern localities show a predominance of red individuals, while those from the north tend more to blackness. Additional field observations are needed in this case to determine whether the development of melanism in *andrei* is the result of low temperature or relatively moist nest sites.

Unlike the variants just discussed, the color of the two subspecies *castaneus* and *flavus*, described below, is quite constant. Moreover, these new forms show regular and significant structural differences which clearly separate them from the typical *andrei*.

Veromessor andrei subsp. **castaneus** subsp. nov.

The most obvious difference between *castaneus* and the typical *andrei* lies in the lighter color of the new subspecies. The entire insect is a uniform castaneous brown with the abdomen no darker (in some specimens lighter) than the head and thorax. The structural differences which distinguish *castaneus*, while less apparent, are of more significance. It is less polymorphic, the largest workers measuring only 5.2 mm. (7 mm. in the typical *andrei*). The antennal scapes are longer, slightly surpassing the occipital border. The tooth and

lamella on the ventral surface of the peduncle of the petiole are much reduced and in some cases lacking entirely, so that the ventral surface of the petiole appears merely sinuate. The epinotal suture is less deeply impressed. In sculpture the subspecies *castaneus* is very similar to the typical *andrei*, although the body hairs are perhaps a little finer and a trifle less numerous.

Described from a large series of workers collected by the senior author at Jacumba and San Diego, Southern California. Jacumba may be regarded as the type locality.

Veromessor andrei subsp. **flavus** subsp. nov.

The color of this form, as the name implies, is yellow. In addition, it differs from the typical *andrei* in a number of structural characters. The head is noticeably narrower, particularly in the posterior half, where the sides are somewhat convergent toward the occiput. The latter is practically flat. The antennal scapes are longer and slightly surpass the occipital border, as in the subspecies *castaneus*. The node of the petiole is smaller and noticeably narrower. The sculpture is more feeble, particularly on the thorax, and the entire insect is less shining.

The types were collected by the senior author on Aug. 17, 1917, at Jacumba, Southern California.

Veromessor chamberlini (Wheeler).

Veromessor chamberlini, Wheeler, Bull. Amer. Mus. Nat. Hist. Vol. 34, p. 410 (1915) ☿ (*Messor*).

Worker: Length 4 mm. (Plate II, fig. 5.)

Head, exclusive of the mandibles, as broad as long, the sides very slightly narrowed from a point just posterior to the eyes to the insertion of the mandibles. Occiput flat, its angles very broadly rounded. Anterior border of the clypeus virtually straight, the median lobe very shallowly impressed in front and with two feeble carinae. Mandibles large, their external border strongly curved; masticatory margin with two sharp, prominent, terminal teeth and a row of denticles along the rest of the margin. Frontal carinae prominent, moderately divergent anteriorly and strongly divergent behind. The antennal scapes in repose fail to reach the occipital border by a distance less than their greatest thickness; the proximal end of the scape flattened and forming a spatulate portion which is wider than the feebly clavate tip. First funicular joint slightly shorter than the

following two together; funicular joints 2–7 all longer than broad though gradually increasing in thickness, the remaining four joints much more thickened and forming a distinct club. Eyes rather small, feebly convex, suboval, situated at the middle of the side of the head.

Promesonotum in profile strongly though somewhat irregularly convex, with the mesonotum descending abruptly to the much lower epinotum, the mesoëpinotal suture feebly impressed. Dorsum of the epinotum very feebly sinuate and much longer than the declivous face, the angle between them armed with two long, feebly arcuate spines which are thin toward the tips but rather thick toward the base. Seen from above, the promesonotum is subpyriform and notably wider than the remainder of the thorax, with the promesonotal suture obsolescent but rather clearly visible in certain lights. Sides of the thorax not constricted at the mesoëpinotal suture, the epinotal spines only moderately divergent and approximately as long as the distance between their tips. Petiole in profile with a long anterior peduncle, which lacks a ventral tooth and increases slightly in diameter toward the node. The sloping anterior face of the node meets the peduncle in a very wide angle, the summit of the node is rounded, the posterior face short and abrupt. The posterior peduncle is short and forms a distinct angle at its junction with the node. Postpetiole in profile with a bluntly angular dorsum and a sinuate ventral face. Seen from above the peduncle of the petiole is compressed anteriorly by two semicircular constrictions, posterior to which it gradually increases in width. Postpetiole from above subpyriform only slightly less than twice as wide as the node of the petiole. Gaster small, oval.

Head entirely covered with fine rugae which diverge from the median line toward the occipital angles; interrugal spaces feebly granulose and somewhat shining. Mandibles with coarse longitudinal striae, feebly shining. Clypeus granulose, opaque except for the median lobe which is rather strongly shining. Frontal area opaque. Antennal scapes smooth, strongly shining. Thorax, except for the pronotum where the rugae are transversely arcuate, entirely covered with strong irregular longitudinal rugae, somewhat more shining than the head. Petiolar nodes very feebly granulose, somewhat shining. Gaster very smooth and shining, the small piligerous punctures scarcely visible. Hairs very irregular both in length and thickness. Gular ammochaetae very poorly developed, consisting of only a few, fine, long hairs. Clypeus with a fringe of rather stout, golden hairs of

irregular length. Front, vertex, and occiput with a number of short, fine, whitish hairs many of which are suberect. Thoracic hairs abundant over the entire dorsum and very irregular in length. Petiole, postpetiole, and gaster with abundant whitish hairs which are more uniform in length than those of the thorax. Femora with a few short erect hairs, those of the tibiae, tarsi, and antennal scapes finer, more numerous, and suberect.

Head and thorax clear, ferruginous red, nodes of the pedicel a duller red, base of the gaster yellowish red, femora, tibiae, and posterior gastric segments piceous brown.

Redescribed from the type series in the collection of the senior author. This consists of a number of workers taken by R. V. Chamberlin on Santa Cruz Island, California. The species is apparently known only from type material. Sexual forms unknown.

Superficially *chamberlini* resembles a small worker of *andrei* but it may be easily distinguished from that species by the flattened base of the antennal scape, broader head, shorter epinotal spines, uniformly feebler sculpture, and notably sparser pilosity.

Veromessor julianus (Pergande).

Veromessor julianus (Pergande), Proc. Calif. Acad. Sci. (2) Vol. 4, p. 164, (1894) (*Aphaenogaster*).

Worker: Length 5–8 mm. (Plate II, fig. 7.)

Head in the largest workers subquadrate, the length from the flat occipital border to the anterior margin of the clypeus very slightly exceeding the greatest width. Head widest just behind the eyes, the width slightly decreasing from that point to the insertion of the mandibles, sides straight or very slightly convex. In the smaller workers the head is somewhat more narrow, widest at the eyes, with the sides feebly convex and the occipital angles more broadly rounded, which gives the occipital border a slightly convex appearance. Clypeus short, scarcely projecting, the anterior edge with an irregular median impression, the median lobe not clearly marked off, the entire middle portion of the clypeus longitudinally striate. Frontal carinae narrow and rather short, feebly divergent in front, their lateral margins only moderately divergent behind and fusing with the head at a point on a level with the frontal area; the latter moderately depressed and subopaque. Mandibles powerful, their exterior margin strongly and evenly curved; teeth poorly developed, the apical two much rounded and forming a terminal lobe at the junction of the

outer and masticatory margins, the remainder of the masticatory margin serrate rather than toothed. Eyes oval, moderately convex, surrounded by a shallow and narrow groove. Antennal scapes straight and slender, the tips not noticeably swollen, the entire scape gradually increasing in diameter from base to apex. In repose the scape surpasses the occipital border by a distance slightly in excess of its greatest thickness. Funicular joints all notably broader than long, joints 2–6 of approximately the same diameter, the remaining joints increasing in thickness and forming a poorly developed terminal club.

Promesonotum seen from above subpentagonal, with the anterior border strongly convex, the two lateral and posterior borders more nearly straight. Promesonotal suture obsolete. Epinotum from above notably narrower than the pronotum, rectangular in outline, the sides not constricted at the mesoëpinotal suture. Spines strongly divergent, straight, the apical two-thirds rather thin, the basal third decidedly thickened; length from base to apex slightly less than the distance between their tips. Seen in profile, the dorsum of the pronotum is feebly convex, that of the mesonotum virtually straight and sharply sloping, the epinotum much depressed, with straight basal and declivous faces which meet at a sharp angle. Declivous face of the epinotum approximately two-thirds as long as the basal face, the spines at their junction only slightly elevated, forming an angle of about twenty degrees with the plane of the basal face. Mesoëpinotal suture not impressed.

Petiole in profile with a long, thick, tapering anterior peduncle which has neither ventral tooth nor lamella. Anterior face of the node sloping forward to form a broad angle with the dorsum of the peduncle. Posterior face of the node strongly convex, meeting the anterior face in a sharp angle at the summit of the node. Posterior peduncle very short. Postpetiole in profile with a rather long and narrow anterior peduncle, the node low, feebly convex above, its posterior face not constricted into a posterior peduncle but broadly applied to the first gastric segment. Seen from above, the petiole is narrow, bluntly cuneate in outline, with the broadest portion at the base of the node. Postpetiole trapezoidal, much narrowed in front and not at all constricted where it joins the gaster, which is large and oval.

Head shining, entirely covered with fine and rather even striae which are interrupted at intervals by small, shallow punctures. The striae on the front diverge from the midline toward the occipital

angles where they are met by longitudinal striae which extend from the insertion of the mandibles to the occipital angles. Mandibles shining, with coarse longitudinal striae. Clypeus somewhat duller, the striae more irregular. Thorax subopaque, the pronotum with close-set, transverse rugae, those on the mesonotum and epinotum more widely separated and irregular. The interrugal spaces densely granulose over the entire thorax, especially on the sides of the pronotum where the granulation largely replaces the rugae. Lower portions of the petiole and postpetiole opaque, very finely granulose, the summits of the nodes, especially the postpetiole, shining. Gaster shining, feebly shagreened, with very small piligerous punctures.

Hairs rather sparse. Gular ammochaetae consisting of about half a dozen long curved hairs on either side of the head. Anterior border of the clypeus with a few long hairs, the remaining hairs on head and thorax all shorter and very uneven in length. Abdominal hairs short and more nearly uniform in length. Femora, tibiae, and tarsi covered with numerous fine erect hairs. Those of the scapes and funiculi very fine but erect or suberect, except on the terminal funicular joints where they grade into pubescence.

Head dingy blackish red, the thorax somewhat clearer red, petiolar nodes and gaster piceous brown. Mandibles, antennae, and legs yellowish brown.

Redescribed from types taken by Pergande at San Julio, Lower California. The sexual forms of this species are unknown and the workers themselves appear to be represented only by the type material. Additional specimens examined by the authors do not belong to the typical *julianus* but to the two variants described below.

Veromessor julianus subsp. **clarior** subsp. nov.

This form differs from the typical *julianus* in the following characteristics:

The head is more nearly quadrate, being almost exactly as long as broad; the antennal scapes are shorter, their tips in repose just reaching the occipital border; the dorsum of the thorax is notably impressed at the mesoëpinotal suture; the epinotal spines are longer and thinner and decidedly more elevated, meeting the plane of the basal face of the epinotum at a forty-five degree angle; the cephalic striae are finer and the granulation of the thorax is much less pronounced. The insect is much more hairy than the typical *julianus*, this difference being especially noticeable in the case of the gular ammochaetae and

the abdominal hairs. The color is a clear, yellowish red, the gaster piceous brown, usually with a yellowish spot at the base of the first segment.

Described from a series of workers taken by H. C. Millender at Commondu, Lower California. Additional specimens agreeing in every particular were taken by Dr. W. M. Mann at Loreto, Lower California.

Veromessor julianus subsp. **manni** subsp. nov.

In this form the dorsum of the thorax is impressed at the meso-epinotal suture, as in the subspecies *clarior*. It differs from *clarior*, however, in its smoother cephalic sculpture, the striae in the smaller specimens being scarcely visible. Furthermore, the epinotal spines are shorter, approaching the condition found in the typical *julianus*. The color of the subspecies is less clear than that of *clarior*, the head especially tending toward a muddy, brownish red. The yellowish spot at the base of the first gastric segment, which appears to be a fairly constant character in *clarior*, is reduced in size or absent altogether in *manni*. In addition this subspecies appears to be smaller than either *clarior* or the typical *julianus*. This distinction must, however, be used with caution since the type series consists of few specimens and it is entirely probable that the examination of additional material will prove this statement to be erroneous. The length of the specimens examined varies from 4.5 mm. to 6 mm.

Described from five specimens taken by Dr. W. M. Mann at Purissima, Lower California.

Veromessor lobognathus (Andrews).

Veromessor lobognathus (Andrews), Psyche, Vol. 23, No. 3, p. 81 (1916) (*Messor*).

Worker: Length 6 mm. (Plate II, fig. 6.)

Head subquadrate, as broad as long (mandibles excluded), the sides approximately straight, a trifle narrower in front of the eyes than behind them. Occiput flat, with the occipital angles broadly and evenly rounded. Anterior margin of the very short clypeus straight, with a shallow V-shaped median impression. Eyes oval, moderately large and feebly convex, placed at the middle of the sides of the head. Mandibles large and strongly convex in two planes, so that the lobed tip of the masticatory margin is carried back beneath the mandible and is not noticeable unless viewed from a point in front of the lower margin. This lobe, which appears to consist of three fused teeth,

is sharply set off from the remainder of the masticatory margin. Frontal carinae subparallel, rather thick and short, with a welt-like portion which extends from the anterior end encircling the front of the antennal fossa. Antennal scapes in repose surpassing the occipital border by an amount slightly in excess of their greatest thickness, the basal end of the scape flattened and strongly spatulate. Distal to the flattened portion the diameter of the scape gradually increases toward the slightly swollen tip. First and last funicular joints of equal length, the remaining joints all much shorter; the diameter of the funicular joints gradually increases distally, so that no distinct club is formed although the apical are almost twice as thick as the basal joints.

Dorsum of promesonotum, seen in profile, evenly and moderately convex; the mesoëpinotal suture with a broad, flattened impression whose posterior boundary is marked by a slight ridge on the basal face of the epinotum. Basal face of the epinotum flat and feebly sloping, forming a sharp angle with the shorter declivous face, their angle armed with two spines of moderate length. Seen from above, the promesonotum is pyriform and notably broader than the remainder of the thorax; the mesoëpinotal suture forms a narrow slotlike groove between the mesonotum and epinotum without constriction of the sides in that area. Epinotal spines feebly divergent and very slightly incurved, their length slightly more than half the distance between their tips.

Petiole, seen in profile, with a thick anterior peduncle whose dorsum forms a continuous slope with the anterior face of the node. Lower surface of the peduncle with a small anterior tooth. Node of the petiole small and low with a flattened summit, which slopes backwards to the short posterior face. Posterior peduncle short and very thick Postpetiole in profile with a feebly convex dorsum and a well-marked impression in the middle of the ventral surface, the posterior portion slightly constricted at its junction with the gaster. Seen from above, the sides of the petiole are parallel as far forward as the two rather prominent spiracles, anterior to which the peduncle is much narrowed by a semicircular impression at either side. Postpetiole almost twice as wide as the petiole, subtriangular. Gaster rather large, oval. Legs long, the femora somewhat incrassated.

Mandibles shining, with rather coarse but shallow longitudinal striae. Clypeus granulose, subopaque. Frontal area shining. Head opaque, completely covered with fine longitudinal rugae, the interrugal

spaces coriaceous. Rugae along the median portion of the head not divergent, the lateral rugae encircling the eye. Antennal scapes finely granulose, feebly shining. Thorax slightly shining, the rugae with which it is completely covered more irregular and coarser than those of the head. Petiole and postpetiole finely granulose, opaque. Gaster and legs shining.

Hairs moderately abundant, stout, erect, and golden. Gular ammochaetae moderately developed, the inner row of long curved hairs flanked at the side by additional hairs which are shorter and less regularly placed. Inner surface of the mandibles with numerous long hairs, those on the outer surface short, fine, and suberect. Clypeus with a fringe of long curved hairs. Except for two or three long hairs on the front, the remainder of the head is covered with short, stout, and rather blunt hairs of fairly uniform length. Hairs on the pronotum about equal in length and abundance to those on the occiput. Hairs on the epinotum much sparser. Petiole with a tuft of very coarse hairs arising from the posterior face of the node. Dorsum of the postpetiole with numerous coarse, long hairs; those of its lower surface, shorter, sparser, and much finer. Hairs on the gaster relatively sparse, uniformly distributed over the first segment; over the rest of the gaster confined to an irregular row at the posterior edge of the segment. Femora with sparse, short, erect hairs; those of the tibiae, tarsi, and antennal scapes shorter, much more numerous, and suberect. Hairs on the funiculi very fine, grading into pubescence toward the tips.

Color clear orange yellow, the posterior gastric segments, except the terminal segment, which bears a castaneous band, somewhat lighter than the remainder of the body. Clypeus and mandibles tinged with brown, the masticatory margin of the mandibles piceous.

Redescribed from a single cotype in the collection of the senior author. *Lobognathus* is apparently known only from the four cotype specimens taken by T. D. A. Cockerell at Glenwood Springs, Colorado.

In her original description of *lobognathus* Miss Andrews stressed the apical mandibular lobe and the spatulate base of the scape as the outstanding peculiarities of this species. In point of fact, *lobognathus* is not unique in either respect, since a similar, though smaller, mandibular lobe occurs in *julianus*, and *chamberlini* possesses a scape with a spatulate base. By far the most outstanding characteristic of *lobognathus* is its extraordinary resemblance to *Pogonomyrmex occidentalis* in sculpture and pilosity. The dull, strongly coriaceous head

with its broad band of circumocular rugae is startlingly similar to that of *occidentalis*. The similarity is further increased by the unusual hairs of *lobognathus*, which are coarse, blunt, and of rather uniform length. Since the hairs in the other species of Veromessor tend to be slender, pointed, and very irregular in length, this difference is all the more surprising. It must be borne in mind, however, that these similarities are superficial and cannot be of phylogenetic significance. In its more fundamental characters, the structure of the thorax, petiolar nodes, clypeus, and frontal lobes, *lobognathus* plainly shows itself to be a true *Veromessor*. Its superficial resemblance to *P. occidentalis* may be explained either as convergence due to similarity of habits and environment or perhaps as mimicry. Certainly the characteristics of *occidentalis* should make it an excellent model since it is by far the most pugnacious and fiercely stinging ant in the area in which *lobognathus* occurs.

It is to be regretted that so little is known of the distribution of *lobognathus*. Its occurrence in the western foothills of the Rockies offers an interesting parallel to that of *andrei* in the Coast Range of California.

Veromessor pergandei (Mayr).

V. pergandei Mayr, Verh. Zool-bot Ges. Wien, Vol. 36, p. 448–449 (1886). (Aphaenogaster).

Worker major: Length 6 mm. (Plate II, fig. 3).

Head, exclusive of the mandibles, as broad as long, widest just behind the eyes and narrowing from this point to the insertion of the mandibles. Anterior to the eye the side of the head is straight, posterior to the eye it is convex, passing through a broadly rounded angle to the straight occipital border. Clypeus scarcely projecting, its anterior edge feebly arcuate, the median lobe with a prominent, blunt central tooth from which several well-marked rugae extend rearward between the antennal lobes. Antennal lobes parallel, not spreading laterally in the rear, the frontal area between them subcircular and opaque. The lateral border of the clypeus and the anterior border of the side of the head together form a very distinct semicircular impression at the base of the mandible. Mandibles massive, their outer border strongly and evenly convex, the masticatory margin feebly concave, armed with two stout teeth at its junction with the outer border and a single smaller tooth at the junction with the inner border, the remainder of the masticatory margin feebly denticulate or smooth. Antennal scapes slender, their tips in repose just reaching

the occipital border. Funicular joints all of approximately the same length and all longer than broad, their diameter gradually increasing apically. The eyes, which are set at the middle of the sides of the head, are large and elongate, with the convex upper orbit meeting the straight lower orbit in a bluntly rounded anterior angle.

Promesonotum, seen from above, subpyriform, the promesonotal suture obsolete above, but its position indicated laterally by a broad impression. Mesoëpinotal suture with a broad and fairly deep impression. Epinotum subtriangular, slightly longer than broad but not as long as the promesonotum, armed posteriorly with a pair of feebly divergent, short, slender spines. Seen in profile, the promesonotum is strongly gibbous and descends to the much lower epinotum through an even curve, except at the point adjacent to the mesoëpinotal suture where the dorsal impression of the thorax gives it a short, steep posterior face. Dorsum of the epinotum in profile straight, except for a low anterior ridge which bounds the rear edge of the mesoëpinotal impression. Epinotal spines short, only slightly elevated, and arming the sharp angle between the basal and declivous faces of the epinotum.

Anterior peduncle of the petiole, seen in profile, thick, its upper face meeting the anterior face of the node in such a wide angle that the two form what is virtually a single slightly concave slope. Lower surface of the peduncle straight or very feebly sinuate, with a small angular tooth at its anterior end. Posterior peduncle very short and thick. Node of the petiole small, its height not equal to the greatest thickness of the anterior peduncle, the summit flattened and sloping rearward to the very short posterior face. Postpetiole in profile lower than the node of the petiole, with its upper surface consisting of a strongly sloping anterior face and a somewhat less sloping posterior face, which meet at the summit in a broadly rounded angle. Ventral face of the postpetiole sinuate. Seen from above, the node of the petiole is scarcely wider than the peduncle and only slightly more than half as wide as the trapezoidal postpetiole. Gaster oval, its anterior edge slightly flattened at either side of its attachment to the postpetiole.

The entire insect shining. Mandibles with numerous coarse longitudinal striae. Head with numerous, small piligerous punctures. Sides of front behind the clypeus with feeble longitudinal striae which extend rearward to the middle of the head. Antennal lobes with similar striae which spread fanwise on the front, disappearing at the

level of the posterior edge of the eyes. The remainder of the head may be highly glabrous or more or less covered with coarse shagreening, heavy enough partially to obliterate the shining character of the surface. Pronotum feebly shagreened, moderately shining. Mesonotum, epinotum, and petiolar nodes finely granulate and feebly shining. Gaster very smooth and shining, with moderately numerous, small, piligerous punctures.

Hairs whitish or yellowish, slender but with rather blunt tips. Those on the under surface of the head and the lower lateral edges of the mandibles very long and numerous, forming well-developed ammochaetae. Hairs on the upper surface of the mandibles very short and subappressed. Clypeal border with numerous long curved hairs. Those on the dorsal surface of the head sparse and of variable length but averaging longer than those of the thorax and pedicellar nodes. Gaster with moderately numerous short hairs all of approximately the same length. Legs clothed with short whitish hairs which are more numerous on the tibiae and tarsi than on the femora. Scapes covered with exceedingly fine hairs which grade into golden pubescence on the apical funicular joints.

Color piceous brown to jet black, the mandibles, antennae, and legs somewhat lighter than the remainder of the insect.

Worker minor: Length 2.5 mm.

Differs from the major in the following characteristics: the head is slightly longer than broad, with the occipital border feebly convex in the middle. The antennal scapes in repose surpass the occipital border by an amount slightly in excess of their greatest diameter, the impression at the mesoëpinotal suture is relatively broader and shallower, the sculpture is feebler, the pilosity, especially that of the gaster, is much sparser.

Medias vary between the extremes described above, depending upon their size.

To date no description of the sexual forms of *pergandei* has appeared in myrmecological literature. The following descriptions are based upon a large series of males and females taken by the senior author in Fenner Canyon, Santa Catalina Mts., Arizona.

Female: Length 10 mm.

Head, mandibles excluded, quadrate, slightly broader than long, the straight sides slightly narrower in front of the eyes than behind them, the occipital angles very broadly rounded, the middle of the

occipital border flat. Mandibles large, their outer margin less strongly curved than in the major worker. Apex of the masticatory margin armed with two long, very stout and sharp terminal teeth, the outer tooth stouter and longer than the inner, but both far larger than the row of short, triangular teeth which arm the rest of the masticatory margin. Clypeus short, its anterior margin feebly projecting and sinuate in the middle. Median lobe with a single projecting tooth as in the major worker. Frontal carinae short and rather flat, not bounding the antennal fossae in the rear, the frontal area between them arrow-shaped, only a little depressed, and feebly shining. Antennal scapes stout, their diameter gradually increasing from base to apex, the tips only slightly turned outward. In repose the scape surpasses the occipital margin by an amount slightly in excess of its greatest diameter. All funicular joints longer than broad, their diameter gradually increasing from base to apex, the first and last joints slightly longer than the rest. Eyes large, moderately convex and reniform in outline, set somewhat behind the middle of the side of the head, with their long axes slanting forward and downward. Ocelli well-developed, the median ocellus varying considerably in size and shape throughout the type series. In some specimens it is round and no larger than the lateral ocelli, in others it is oval and notably larger.

Thorax bulky, oval when seen from above; its greatest width, which occurs behind the middle of the scutum, slightly more than half its length. Scutum large, its evenly and strongly convex anterior edge completely obscuring all but the projecting neck of the pronotum when the thorax is viewed from above. Paraptera poorly developed and apparently fused to the adjacent portions of the scutum and scutellum; the former sutures being indicated merely by impressions at either side of the paraptera. Scutellum subtrapezoidal with the angles rounded, largely concealing the metanotum when seen from above. Epinotal spines seen from above short and stout, with rather bluntly rounded tips. Seen from the side, the almost vertical anterior face of the pronotum is overhung by the bulging forward edge of the scutum. The greater part of the scutum and the scutellum together form a straight dorsum to the thorax. Mesothoracic sternite separated from the epimeron by a well-marked impression. Basal and declivous faces of the epinotum not sharply separated, together forming a single steep and slightly convex slope with the two bluntly triangular epinotal spines at the middle.

Peduncle of the petiole very thick, with a prominent antero-ventral tooth. Seen in profile, its dorsal face forms an unbroken slope with the anterior face of the node. The latter is small, triangular, and with a narrow though blunt summit. Posterior peduncle of petiole exceedingly short and thick. Postpetiole cupshaped in profile, larger than the petiole, with a very short anterior peduncle and no posterior peduncle, the entire, wide, posterior face being applied to the surface of the gaster. Seen from above, the node of the petiole is only about three-quarters as wide as the subcuneiform peduncle below it. Postpetiole subtrapezoidal, with the lateral faces slightly convex, its greatest width two-fifths again as wide as the petiole. Gaster long, suboval, with a flattened anterior border. Femora not incrassated. Wings tinged with yellow, the veins and stigma brownish yellow.

Mandibles shining, with strong, subparallel rugae. Portion of the clypeus adjacent to the median tooth with longitudinal rugae, the lateral portions finely granulose, the granulation being replaced at the extreme ends by striae which are carried backwards onto the front and curving around the lateral edges of the antennal fossae. Frontal carinae with longitudinal striae, which spread fan-wise on the vertex but do not reach the occiput. The entire head covered with small, piligerous punctures. These are most numerous on the vertex and occiput where they tend to replace the longitudinal striae which become very feeble on the posterior parts of the head. On the front the punctures are sparser and at the anterior edge of the head, where the striae are heavy, they disappear altogether. Thorax in large part smooth and more shining than the head. The scutum and scutellum with scattered punctures smaller than those on the head. Lateral portions of the pronotum, the epimeron and the upper part of the mesothoracic sternite coriaceous, with very feeble striae impressed upon the coriaceous marking so that these parts appear striate or coriaceous, depending upon the angle of illumination. Lower portion of the mesothoracic sternite and epinotum with coarse, wavy, longitudinal rugae, the interrugal spaces finely granulose and less shining than the remainder of the thorax. Petiolar nodes coriaceous, scarcely shining. Gaster strongly shining, feebly shagreened, with scattered small puncture.

Pilosity as in the major worker except for the gaster, on which the hairs are less uniform, those at the edge of each segment being longer, thicker, and more numerous than elsewhere.

Color piceous black, the mandibles, anterior border of the head, funiculi, and tarsal joints clear, reddish brown; the scapes, tibiae, femora, and abdomen piceous brown.

Male: Length 8.5 mm.

Head small, quadrate, notably wider behind the eyes than in front of them, the feebly convex occipital border passing through much-rounded occipital angles to the very short part of the sides which lies behind the eyes. Mandibles as in the female, except that they are relatively much less massive and somewhat narrower. Anterior border of clypeus feebly convex, with a broad median impression, the median lobe projecting but without the central tooth characteristic of both major worker and female. Eyes large, suboval in outline, with their anterior border carried well under the genae. The antennal scapes in repose reach the lateral ocelli. All funicular joints longer than broad, their diameter gradually increasing from base to apex of the funiculus. First funicular joint subcampanulate or trumpet-shaped, notably broader than the adjacent joint although not equalling it in length. Funicular joints 2–6 as broad basally as apically, joints 7–11 subovoidal, with the basal ends somewhat constricted, the terminal joint rather sharply pointed and as long as the two preceding joints together.

Thorax bulky. In profile the scutum shows a flat posterior half and a strongly convex anterior portion which slightly overhangs the pronotum. Scutellum in profile with its anterior edge slightly higher than the adjacent portion of the scutum from which it is separated by a broad suture. Posterior edge of the scutellum overhanging the very short, strap-like metanotum. Basal face of the epinotum longer than the declivous face, the angle between them well-marked and armed with a broad, short, somewhat rounded tooth at either side. Seen from above the thorax is suboval, the anterior border evenly convex, the declivity of the epinotum forming a flat, truncated posterior face. The greatest width of the thorax occurs at the posterior third of the scutum. Mesothoracic paraptera virtually obliterated, their place being taken by a broadly impressed suture between the scutum and the scutellum. Notauli absent.

Nodes of pedicel as in the female, except that the posterior face of the postpetiole is even more broadly applied to the anterior surface of the first abdominal segment without any constriction between the two. In profile this gives the postpetiole the appearance of being a narrowed portion of the gaster rather than a separate node.

Head and mandibles finely striate-granulose and feebly shining. Median lobe of clypeus irregularly rugose, in some specimens with a median crest extending back onto the front. Dorsum of the thorax shining, the sculpture coarser but notably sparser so that there are large glabrous areas, particularly in the middle of the scutum. Sides and lower portions of the thorax feebly shining or opaque, densely striate-granulate. Petiolar nodes finely granulose, opaque. Abdomen strongly shining, rather strongly shagreened, and with numerous small punctures.

Hairs numerous, golden, erect or suberect, curved, fairly long, and of about equal length on head, thorax and abdomen. Those on the gulae and mentum form a small but distinct psammophore. Hairs on the legs short, fine, and suberect. Those on the antennae finer and appressed.

Color piceous black, the apical third of the mandibles and all of the tarsal joints castaneous brown, the funiculi castaneous basally but becoming clear, golden yellow toward the apex. Wings as in the female.

In his original description Mayr cites California as the type locality of *pergandei*. The authors have seen material from the following localities:

California: Mojave. (J. C. Bradley and A. Wetmore.)
Apple Valley. (E. C. Jaeger.)
Santa Barbara (F. E. Clements.)
Palm Springs, Needles, Lakeside, Claremont. (W. M. Wheeler.)
Coachella Valley. (S. F. Light.)
Elsinore. (C. F. Baker.)
Otis, Perris. (J. C. Bradley.)
Victorville. (W. S. Creighton.)
Fresno. (Woodworth.)
Salton Sea, San Jacinto, Moore Canyon, Menifee, San Diego County. (No collector.)

Arizona: Nortons, Tempe, Casa Grande, Gila Bend Mts., Fenner Canyon, Santa Catalina Mts., Yucca, Yuma. (W. M. Wheeler.)
Ft. Mojada. (J. Henderson.)
Tucson. (G. von Krockow, W. M. Wheeler, E. A. Carpenter, N. C. Skinner.)

Mexico: San Julio, Lower California. (Eisen?)
Santa Borja, Lower California. (C. D. Haines.)

The examination of a large amount of material in the collection of the senior author shows that *pergandei* exhibits a certain degree of morphological instability. That slight differences in color and sculpture do occur has been noted in the foregoing descriptions. It is, moreover, also possible to select individuals in which the length of the epinotal spines is reduced. This last character is usually confined to the minor worker, a caste in which the spines are sometimes replaced by mere angles. Were any of these variable characters constant throughout a series from a single nest they might be utilized as a basis for varietal status. Actually, however, any or all of them may appear in a nest series and this, in the opinion of the authors, unfits them for use as taxonomic characters.

Of all the species in the genus Veromessor, *pergandei* appears to be most completely adapted to a xerophilous mode of life. This might logically be inferred from the structural characters because of the unusual development of the ammochaetae. In this species not only are the gular and mental hairs very long and numerous but, in addition, they are augmented by another row of hairs arising along the lower lateral border of each mandible. These accessory ammochaetal hairs do not occur in the other species of Veromessor. An examination of the locality records presented above will show that *pergandei* occurs in areas of extreme aridity and high temperature. The fact that a number of the records come from the Mojave and Imperial Deserts needs no further comment to anyone familiar with the climatic conditions in those areas.

The habits of *pergandei* have been summarized by the senior author as follows: "The nests are single or more rarely multiple craters, much flattened, with rounded slopes, 50 cm. or more in diameter, and with one to three large and very irregular central openings. Sometimes these are slit-shaped and as much as 5 or 6 cm. long. The rough galleries and granaries are excavated to a depth of at least 60 cm. in the hardest and most sunbaked portions of the desert soil. Late in the afternoon long files of workers may be seen in the full activity of harvesting. Sometimes these files may be followed for a distance of 20 or 30 meters from the nest before the ants disperse among the scant vegetation in search of seeds. They seem to have no preferences, but eagerly seize all the mature seeds they find and carry them to the nest where they carefully remove the husks and store the edible kernels in the granaries. The chaff and seed-pods are then carried out and dumped on the kitchen midden, which forms a crescentric or circular

zone at the periphery of the crater. Sound seeds are often thrown out with the chaff and eventually germinate, so that old nests are often marked by a circlet of growing plants. . . ."

It may be added that *pergandei* is one of our few desert ants that does not remain in the nest during the middle of the day in the summer months. The junior author observed it foraging at noon on the Mojave Desert in August. The temperature optimum for this insect must be exceedingly high and this point offers interesting ecological possibilities for anyone who has the temerity and constitution necessary for a mid-summer study of the species.

Veromessor relictus (Wheeler and Mann).

V. relictus (Wheeler and Mann), Bull. Amer. Mus. Nat. Hist. Vol. 33, p. 25, fig. 8c. (1914). ☿ ♀ ♂ (Aphaenogaster).

Worker: Length 4–5 mm. (Plate II, fig. 4.)

Head, exclusive of the mandibles, one and one-third times as long as broad, the sides slightly convex, scarcely narrowed from the eyes to the insertion of the mandibles, more strongly narrowed toward the occiput. Occipital angles very poorly marked, the occipital border narrow and somewhat convex. Mandibles of moderate size, their outer margin straight, except at the apex where it suddenly curves inward. Masticatory margin armed with two long, sharp, terminal teeth, with a smaller tooth just inside them, the remainder of the margin feebly serrate. Clypeus not strongly projecting, its anterior edge evenly convex and coarsely serrate, with a notch in the middle. Median lobe of the clypeus well developed, much longer than broad. Frontal carinae very narrow and strap-like, scarcely covering the antennal insertions, their subparallel posterior portions largely obscured by the heavy cephalic sculpture. Antennal scapes long, very little curved, evenly increasing in thickness toward the apex, with a trumpet-shaped expansion at the base. In repose the scapes surpass the occipital border by two-fifths of their length. All funicular joints longer than broad, the first only a little shorter than the two succeeding joints taken together; joints 2–10 approximately the same length but gradually increasing in thickness, the terminal joint as long as the two preceding joints taken together. Eyes of moderate size, round in outline, strongly convex, and situated just a trifle in front of the middle of the sides of the head.

Seen from above, the neck of the pronotum is rather narrow and projects strongly. Behind this the anterior edge of the pronotum is

very strongly rounded, as are the lateral portions where it passes into the mesonotum. The latter is notably constricted in front but increases in width behind. This gives the promesonotum a violin-shaped outline when seen from above. Epinotum from above subrectangular, the sides not constricted at the mesoëpinotal suture. Epinotal spines from above feebly divergent and almost straight, with their slightly thickened bases set well apart. Seen in profile, the dorsum of the promesonotum forms a single feebly convex surface. There is a wide, though shallow, impression of the dorsum at the mesoëpinotal suture. Basal face of the epinotum straight, not much lower than the promesonotum, and almost twice as long as the steeply sloping declivous face. Epinotal spines acute, sharply elevated, and slightly deflected.

Petiole, seen in profile, with a rather thick anterior peduncle which is strongly narrowed in front of the spiracular openings. Behind these its upper surface forms an unbroken concavity with the anterior face of the node. The latter has a sharp crest and a convex posterior face which slopes steeply to the short, thick posterior peduncle. Seen from above, the anterior peduncle of the petiole gradually increases in width to the base of the node, which is no wider than the peduncle itself at that point and narrower than the thick posterior peduncle. Postpetiole from above narrower in front than the adjacent portion of the petiole but rapidly expanding behind, the sides evenly convex. Postpetiole in profile with a moderately concave upper surface, its ventral surface with a pronounced, rounded, anterior fold or tooth. The greatest width of the petiole is scarcely more than one-half that of the postpetiole. Gaster oval, somewhat larger than the head. Legs long and stout.

Mandibles feebly shining and covered with longitudinal striae. Head and thorax strongly reticulate-rugose with the interrugal spaces strongly granulose. On the thorax this sculpture obscures the sutures to such an extent that it is difficult to see them unless the insect is held in such a position that the suture is revealed by the impression adjacent to it. Dorsal and ventral surfaces of the anterior peduncle smooth and shining. The remainder of the petiole, the entire postpetiole, the greater part of the dorsum of the first gastric segment, the antennal scapes, the neck of the pronotum, the fore coxae, and the fore and middle femora densely granulose and opaque. Hind femora, tibiae, and the dorsal edges of the abdominal segments more feebly granulose and somewhat shining. Epinotal spines smooth

apically but feebly striate or granulose at the base. Ventral surface of the abdomen smooth and shining.

Hairs moderately long, in color whitish tinged with brown, rather numerous on the head, promesonotum, and fore femora; sparser on the middle and hind femora, the epinotum, and petiolar nodes; abundant on the abdomen. Scapes and tarsi with numerous fine, short, suberect hairs. Funiculi with similar hairs which grade into pubescence toward the tips.

Color jet black, the mandibles rich, reddish brown, the tarsi and funiculi a somewhat duller brown. In some specimens the postpetiole and a large part of the first gastric segment adjacent to the postpetiole may be orange yellow. In other specimens these areas are black.

Redescribed from type material in the collection of the senior author.

For the characteristics of the sexual forms the reader is referred to the original description of this species.

Relictus is known only from the material taken by Dr. W. M. Mann at Diquini, Petionville, Port au Prince, and Jacmel in Haiti. The exact status of this curious insect is difficult to determine. The length of the head and the antennal scapes certainly suggest a relationship to Aphaenogaster rather than to Veromessor, since in the latter group the head is usually quadrate, with scapes which do not greatly surpass the occipital margin. On the other hand, the structure of the thorax and petiolar nodes relates *relictus* to Veromessor rather than to Aphaenogaster. It may subsequently be necessary when *relictus* is better known to set up a separate genus to receive it. It is not likely to be confused with any other species of Veromessor. Its exceedingly coarse, reticulate sculpture and the granulose dorsum of the first gastric segment separate it from any of the others in the genus. Our only observation on the habits of this ant is that of Dr. Mann, who states that: "it nests in holes beneath stones in moist localities, usually on hillsides. The workers are timid and very rapid in their movements."

Veromessor relictus subsp. **epinotalis** (Wheeler and Mann).

V. relictus subsp. *epinotalis* (Wheeler and Mann), Bull. Amer. Mus. Nat. Hist. Vol. 33. p. 27, fig. 8a. (1914). ☿ (Aphaenogaster).

Only the worker of this form is known. It differs from the typical *relictus* in having shorter and straighter epinotal spines and a pronounced impression on the dorsum of the epinotum. Type locality: Manneville, Haiti (W. M. Mann).

Veromessor stoddardi (Emery).

V. stoddardi (Emery), Zool. Jahr. Syst. Vol. 8, p. 307, (1895). (Stenamma (Messor)).

Worker: Length 4–6 mm. (Plate II, fig. 1.)

Head exclusive of the mandibles as broad as long, with approximately straight sides, which are slightly narrowed in front of the eyes. Occipital angles only slightly rounded, the flattened portion of the occipital border, which extends almost the full width of the head, with a broad and very feeble median excavation. Clypeus feebly projecting, its anterior edge with a broad, rounded, and rather shallow median impression. Median lobe of the clypeus without carinae but with prominent longitudinal rugae at either side, approximately rectangular in outline and extending well back between the rather short frontal carinae. Frontal area triangular, slightly depressed, opaque. Mandibles large and triangular, the outer margin moderately and evenly curved, the junction between the outer and masticatory margins armed with two large blunt teeth which are set close together and form a small terminal lobe to the mandible, the remainder of the masticatory margin feebly and irregularly serrate. Eyes of moderate size with 16–18 facets in their greatest diameter, feebly convex and circular in outline, except for a small straight ventral portion. The posterior margin of the eye lies at the middle of the side of the head. The antennal scapes in repose fail to reach the occipital margin by a distance twice as great as their maximum diameter. Basal two-thirds of the scape viewed from front straight and thin, the apical third strongly swollen, with the tips turned slightly outwards. Funicular joints gradually increasing in thickness apically, all of about the same length except the basal and terminal joints, which are slightly longer than the rest.

Promesonotum, seen from above, with an evenly rounded anterior border which passes without distinct humeral angles into the straight sides, the latter converging strongly toward the mesoëpinotal suture where they meet the short, transverse posterior border in a rather sharp angle. Sides of the thorax not constricted at the mesoëpinotal suture, the epinotum subrectangular in outline, slightly narrower behind than in front and with the sides strongly sloping inward to the dorsum. Epinotal spines slender, feebly divergent, and shorter than the distance between their bases. Seen in profile, the promesonotum is evenly though feebly convex and notably higher than the epinotum to which it abruptly descends by means of a short, almost perpen-

dicular posterior face. Mesoepinotal suture broad and prominent though not deeply impressed. Basal face of the epinotum with a short, straight anterior portion which forms a distinct angle with the longer, strongly slanting posterior portion. Declivous face of the epinotum short, only slightly more sloping than the posterior half of the basal face, the very wide angle between the two faces armed with short, straight, acute spines.

Petiole, in profile, with the thick anterior peduncle increasing in diameter toward the base of the node and bearing a prominent ventral lamella. Node small, somewhat inclined backwards, the summit blunt and rounded, the anterior face forming a very wide angle with the dorsum of the peduncle, the posterior face meeting the short, thick posterior peduncle at a sharper angle. Postpetiole in profile notably larger than the node of the petiole, its dorsum strongly gibbous and passing posteriorly to a very thick posterior peduncle; ventral face notably concave, with a marked, angular, ventral projection at its anterior border. Seen from above, the anterior portion of the peduncle of the petiole is notched at either side by an angular constriction. Posterior to these notches the petiole is bluntly cuneiform, widest behind the node, and one-half as wide as the suboval postpetiole. Gaster oval, its anterior border not flattened at the insertion of the postpetiole but with the portions immediately adjacent to the postpetiole bearing very short, even, parallel striae which give it the appearance of the milled edge of a coin. Femora rather strongly incrassated.

Head feebly shining, its anterior half covered with fine, subparallel rugae which are interrupted by numerous, coarse, punctures. On the posterior half of the head they are less prominent and more irregular, degenerating into wavy areas separating the numerous large, elongate punctures. Mandibles moderately shining, with somewhat coarser rugae than the head. Lateral portions of the clypeus finely punctate, the median lobe with a few longitudinal rugae at either side. Antennal scapes shagreened. Promesonotum less shining than the head, the dorsum with fine parallel striae, the sides dull and striate-granulose. On the epinotum the granulation almost completely replaces the striation except for certain portions of the pleura. Petiole and postpetiole densely granulose. Gaster shining, feebly shagreened, with numerous very small piligerous punctures.

Hairs on the body short, numerous, erect and golden. Their length is fairly uniform, except for a few somewhat longer ones on the petiolar

nodes, promesonotum, and front of the head. The hairs on the genae, gula, and mentum are short and do not form ammochaetae. Hairs on the legs abundant, short, and erect. Antennal scapes with numerous fine short erect hairs. Funiculi with very fine hairs which are replaced by pubescence on the apical joints.

Color rich reddish or yellowish brown, the borders of the mandibles and the abdomen piceous brown.

It may be noted here that in the smaller workers the head is slightly longer than broad and the antennal scapes extend almost to the occipital border. In other respects they conform to the above description.

Sexual forms unknown.

Redescribed from type material in the collection of the U. S. National Museum. The type series comes from several localities all in San Diego County, California. It seems preferable, for this reason to regard San Diego County as the type locality. *Stoddardi* would seem to be rare or very local in its distribution. The senior author has taken one worker at Jacumba, California, on the border of Mexico, but with the exception of this specimen the species appears to be known only from type material.

Because of its unusually short epinotal spines, *stoddardi* is not likely to be confused with any of the other species in the genus, with the possible exception of *pergandei*. In the case of the latter species, however, there are so many other differences that confusion is extremely unlikely. The dark color, elongate eyes, well-developed ammochaetae, and smooth integument of *pergandei* all serve to distinguish it from *stoddardi*.

Nothing is known of the habits of *stoddardi*. Mention has already been made of the lack of ammochaetae in this species, and their absence might be taken to indicate incomplete xerophilous adaptation. It is to be hoped that subsequent field observations will round out our knowledge of this species.

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EXPLANATION OF THE PLATES.

PLATE I.

FIGURE 1. Head of *N. cockerelli* E. André. ♀.
FIGURE 2. Head of *N. manni* sp. nov. ♀.
FIGURE 3. Head of *N. albisetosus* Mayr. ♀.
FIGURE 4. Thorax of *N. cockerelli* E. André. ♀.

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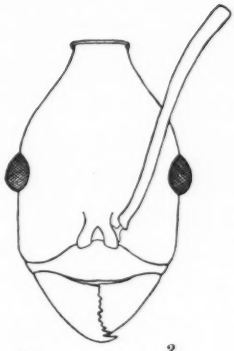

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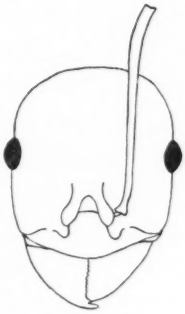

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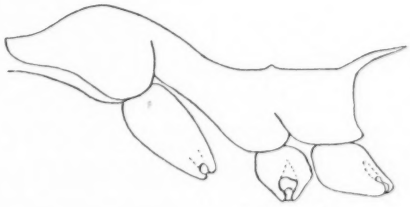

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Plate II.

Thorax and pedicel of various species of Veromessor.

Figure 1. *V. stoddardi* Emery. ☿.
Figure 2. *V. andrei* Mayr. ☿.
Figure 3. *V. pergandei* Mayr. ☿.
Figure 4. *V. relictus* Wheeler and Mann. ☿.
Figure 5. *V. chamberlini* Wheeler. ☿.
Figure 6. *V. lobognathus* Andrews. ☿.
Figure 7. *V. julianus* Pergande. ☿.